

What is claimed is:

1. An engine starting apparatus for starting an engine by using at least a starter, comprising

a catalyst condition judging means for judging whether a catalyst for purifying exhaust gas in the engine is in an inactive condition or not, wherein when starting the engine, if the catalyst is judged to be in an inactive condition, the engine is started at high speed, compared with the engine speed when the catalyst is in an active condition.

2. An engine starting apparatus as claimed in claim 1, comprising a first starter having a high torque type output characteristic and a second starter having a high speed type output characteristic,

wherein the engine is started at high speed by using the second starter.

3. An engine starting apparatus as claimed in claim 1, wherein

said catalyst condition judging means judges that the catalyst is in an inactive condition when the temperature of the catalyst is lower than a predetermined temperature.

4. An engine starting apparatus as claimed in claim 1, wherein

said catalyst condition judging means judges that the catalyst is in an inactive condition when oil temperature or coolant temperature of the engine is lower than a first predetermined temperature.

5. An engine starting apparatus as claimed in claim 1, wherein

said catalyst condition judging means judges that the catalyst is in an inactive condition when the engine has been in a stopped condition for more than a predetermined length of time.

6. An engine starting apparatus as claimed in claim 1, wherein the engine starting apparatus is used in

an engine automatic stopping/starting system which automatically controls the stopping and restarting of said engine, and wherein

said catalyst condition judging means judges that the catalyst is in an inactive condition when the engine is started by operating an ignition key but not when the engine is restarted by the engine automatic stopping/starting system.

7. An engine starting apparatus as claimed in claim 1, further comprising motor control means for controlling an output characteristic of a motor provided in said starter, and wherein

the motor control means controls the output characteristic of the motor to a high speed type, thereby allowing the engine to be started at high speed.

8. An engine starting apparatus as claimed in claim 7, wherein

said motor control means controls the output characteristic of the motor to the high speed type by reducing the field current of the motor.

9. An engine starting apparatus as claimed in claim 8, wherein

said motor has a series coil and a shunt coil, and

said motor control means comprises an energization circuit which can energize the shunt coil in such a manner that the field current flowing in the shunt coil is opposite in direction to the field current flowing in the series coil, and the motor control means reduces the field current of the motor by controlling, through the energization circuit, at least either the amount of the current or the direction of the current flowing in said shunt coil.

10. An engine starting apparatus as claimed in claim 8, wherein

said motor control means includes a field current reducing means capable of reducing the field

current flowing in a field coil (series coil) of the motor, and the motor control means reduces the field current of the motor by using the field current reducing means.

11. An engine starting apparatus as claimed in claim 8, wherein

said motor control means reduces the field current of the motor in accordance with the number of revolutions of the engine or the starter.

12. An engine starting apparatus as claimed in claim 10, wherein

said motor control means reduces the field current of the motor in accordance with a crankshaft position in the engine.

13. An engine starting apparatus as claimed in claim 12, wherein

said motor control means reduces the field current of the motor after a piston reaches the top dead center in any one of cylinders after a start of the engine.

14. An engine starting apparatus as claimed in claim 8, wherein

said motor control means sets an electric current value that maximizes the output of the motor as a control target value for the field current.

15. An engine starting apparatus as claimed in claim 8, wherein

said motor control means stops the field current reducing control when an oil temperature or a coolant temperature of the engine is lower than a second predetermined temperature which is lower than the first predetermined temperature for judging whether the catalyst is in an inactive condition or not.

16. An engine starting apparatus as claimed in claim 8, wherein

said motor control means stops the field current reducing control when an oil temperature or a

coolant temperature of the engine is higher than a third predetermined temperature which is higher than the first predetermined temperature for judging whether the catalyst is in an inactive condition or not.

17. An engine starting apparatus as claimed in claim 8, wherein

said motor control means stops the field current reducing control when the speed of the engine or the starter has failed to reach a predetermined speed.

18. An engine starting apparatus as claimed in claim 8, wherein

said motor control means stops the field current reducing control when a battery is in a low state of charge.

19. An engine starting apparatus as claimed in claim 9, comprising

a power supply means for passing a field current to the shunt coil, separately from a battery, wherein

said motor control means stops reducing the field current when the power supply means is at lower state of charge than a predetermined battery charge level.

20. An engine starting apparatus as claimed in claim 7, wherein

said motor provided in the starter is a DC motor.

21. An engine starting apparatus as claimed in claim 2, wherein

the engine is started by using the first starter when an oil temperature or a coolant temperature of the engine is lower than a second predetermined temperature which is lower than the first predetermined temperature for judging whether the catalyst is in an inactive condition or not.

22. An engine starting apparatus as claimed in claim 2, wherein

the engine is started by using the first starter when oil temperature or coolant temperature of the engine is higher than a third predetermined temperature which is higher than the first predetermined temperature for judging whether the catalyst is in an inactive condition or not.

23. An engine starting apparatus as claimed in claim 2, wherein

when the engine was started using the second starter but, if the speed of the engine or the second starter failed to reach a predetermined speed, the engine is started by switching from the second starter to the first starter.

24. An engine starting apparatus as claimed in claim 2, wherein

the engine is started by using the first starter when the state of charge of a battery is low.

25. An engine starting apparatus as claimed in claim 1, wherein

when the engine speed is higher than a predetermined speed, the amount of fuel injection is reduced compared with a case where the catalyst is in an active condition.

26. An engine starting apparatus as claimed in claim 25, wherein

when the engine speed is higher than the predetermined speed, the amount of fuel injection is reduced depending on air/fuel ratio.

27. An engine starting apparatus as claimed in claim 1, wherein

fuel injection is started after it is detected that an intake manifold pressure in the engine is lower than a predetermined value.

28. An engine starting apparatus as claimed in claim 1, wherein

fuel injection is started after it is detected that the engine speed is higher than a

predetermined speed.

29. An engine starting apparatus as claimed in claim 1, wherein

fuel injection is started after it is detected that the total rpm of the engine counted from the starting of the engine has reached a predetermined value.

30. An engine starting apparatus as claimed in claim 1, wherein

fuel injection is started after it is detected that a predetermined time has elapsed from a start of the engine.

31. An engine starting apparatus as claimed in claim 1, wherein

when starting the engine by driving the engine at high speed, a threshold speed for perfect combustion is changed according to the engine speed.

32. An engine starting apparatus as claimed in claim 31, wherein

when the engine speed has reached the threshold speed for perfect combustion, operation of the starter is stopped.